

CHAPTER 2

PLANNING UTILITY SYSTEMS

2-1. General considerations.

In the Arctic and Subarctic, utility systems are usually the most costly component in construction of military installations. The layout of a new installation is often controlled by the type of distribution and collection systems selected for the utilities network. As a result, planning for a new installation in the cold regions must include consideration of utilities at a very early stage to ensure overall cost effectiveness.

a. Useful life. The useful life for utility systems and equipment in cold regions is shorter than for the same units operated in more temperate climates. Items of equipment that must operate throughout the winter are particularly critical. Trucks used for water delivery or waste collection are examples. Table 2-1 presents typical useful lives for some utilities components in the Arctic and Subarctic.

Table 2-1. Approximate useful life of utility system components in cold regions

Component	Useful Life (years)
Wells	30
Pumps and controls	5
Storage tanks	40
Water distribution lines	40
Meters	10
Valves	10
Sewage collection lines	30
Lift stations (not pumps)	30
Buildings	30
Paint (exterior)	10
Service connections	10-15
Trucks	4
Tracked vehicles	2-3
Backhoe (occasional use)	6-10
Compressor	5

b. Construction methods. The three basic construction techniques used are modular, stick built, and prefabricated. The method selected must depend on site conditions and transportation facilities available. Modular construction, where the entire facility or a major component is preassembled and shipped via barge to the point of use, has been widely used at oil field developments on the northern coast of Alaska. It is advantageous in these locations since large barges can be used, the construction season is short, and labor is very expensive. Barges can usually begin to arrive in Barrow, Alaska, and the Eastern Arctic around the

first of September. This means that non-modular construction materials must be shipped a year in advance and stockpiled for the next construction season. The stick-built approach, where all fabrication is done on site, and the prefabrication approach, where some components are preassembled at the point of manufacture, are more common at interior locations where transport is limited to air or small rivers. Prefabrication of insulating piping units has been shown to be cost effective for remote locations. The normal construction season varies from two or three months along Alaska's Arctic Coast to six or eight months in southern areas of Alaska.

2-2. Installation layout.

The arrangement of buildings and other facilities at military installations must be as compact as possible to reduce utility construction and operation and maintenance (O&M) costs. Unserved areas and large open spaces such as storage yards, parks and playgrounds must be located on the outskirts of the installation. If possible, buildings must be located so as not to "shade" smaller structures from either sun or wind. Improper location of large buildings results in excessive snow drifting and burial of smaller structures. Doors and entry-ways to buildings must not be on the windward or leeward sides if possible to avoid drift interference. Orientation of the structure with the long axis parallel to the prevailing wind direction will reduce drifting problems. Roads and walkways will be constructed slightly above the general ground surface to avoid drifting problems, and construction in cut sections will be avoided if possible. Access points (manholes, service boxes, etc.) for utility system maintenance must be located so that entry can be guaranteed during the winter months.

a. Utility networks. The truck delivery of water and collection of wastes is still used at many civilian communities in Alaska, Canada and Greenland. However, at most U.S. military installations in the Arctic and Subarctic it will be more cost effective to provide piped systems for water supply and wastewater collection. The capital costs for piped systems are higher than for the truck delivery but operation and maintenance costs are significantly lower. The critical planning decisions for utility networks are (1) whether the pipes should be above or below ground, and (2) whether the pipes should be

installed as individual units or combined with other utility services in a utilidor. Above-ground utilidor systems offer easier access for maintenance and repair, and are cheaper to build where site conditions are poor. However, there are disadvantages. Above-ground units are exposed to extreme winter conditions and must have additional thermal protection (see chapter 12) as compared to a buried system. Above-ground systems are susceptible to vandalism and traffic damage, they disrupt pedestrian and vehicle traffic patterns, and create snow removal problems. In general, below-ground installation will be adopted wherever possible. In the Subarctic, an unfrozen zone may exist between the maximum seasonal frost penetration and the top of the permafrost. This condition can also exist in the Arctic near lakes and rivers, and on slopes with southern exposure. Pipes buried in permafrost or in the seasonal frost zone must not only be protected from freezing but must also resist the structural effects of heaving in the seasonal frost zone or thawing of permafrost. The terrain is relatively flat in much of the Arctic, and maintenance of the necessary grades for gravity sewers in either the above-ground or buried mode is difficult. Small pump stations, or pressure or vacuum sewer systems must be used to overcome these constraints.

b. Network layout. A compact installation layout will make a central heating plant practical. This will reduce costs and energy consumption and also reduce the risk of fire. Service lines from utility mains to individual buildings are the main source of freezing problems. Buildings will be as close to the mains as possible with service lines 60 feet or less in length. It is typical practice in temperate climates to bury most utility lines in the streets. However, there are thermal disadvantages to this practice in cold regions since clearing the roads of snow will allow greater frost penetration. Burying water and sewer mains in the front or back yards of dwellings, and in open areas where snow will not be removed, will maintain warmer ground and pipe temperatures. Installation layouts should not be designed with dead-end streets. Dead-ends are difficult and expensive to service with circulating water systems and snow removal is more difficult. The largest consumers of water will be located at the extremities of the distribution system, if possible.

2-3. Equipment.

For remote arctic installations the initial cost of most utility equipment is not as important as its reliability. A large inventory of critical spare parts is recommended and standardization of equipment to reduce the parts inventory will prove economical.

Standby units for critical equipment are essential and are particularly important for emergency power and for heating systems. Humidity is a critical factor in enclosed spaces and both high and low extremes can be experienced in arctic situations. Since natural humidity is extremely low due to the low winter temperatures, humidifiers (to maintain humidity at about 30 percent) may be desirable in personnel spaces. Very high humidity is experienced in pump stations and enclosed treatment works, and thus condensation may occur on cold surfaces causing damage and inconvenience.

2-4. Revegetation.

Areas excavated and backfilled for utility systems must be revegetated to prevent erosion. A revegetation procedure is summarized in table 2-2 for tundra areas. These grasses will die out in four to five years but the natural vegetation will have developed by that time. The initial seeding and fertilization will take place after the ice breaks up on local streams but before mid-summer. As indicated in table 2-2, a nitrogen-phosphorus-potassium (N, P, K) fertilizer will be applied with the initial seeding and then supplemental nitrogen at the beginning of the second growing season.

Table 2-2. Revegetation for tundra areas

Grass Seed Type	Rate (lb/acre)
Meadow foxtail (common)	18
Hard fescue (Durar)	18
Red fescue (arctared)	27
Annual ryegrass (<i>Lolium multiflorum</i>)	27
Total	90
Fertilizer	Rate (lb/acre)
First year (apply with seed)	
10(N) - 20(P) - 10(K)	358
Second year	
33 - 0 - 0	90